CLAIMS

I claim:

5 1. In a packet switched computer network, a method of estimating periodic worst-case delay

for a traffic aggregate having an associated rate, the method comprising:

    collecting traffic data at a queue associated with the traffic aggregate over a time

interval;

    calculating a traffic profile responsive to the collected traffic data and the associated

10 rate;

    calculating a periodic worst-case delay for the traffic profile.

2. A method as in claim 1 wherein the traffic data includes packet size and arrival time of

each packet arriving at the queue during the time interval.

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3. A method as in claim 2 wherein calculating the profile includes calculating a value of a

burst parameter given the associated rate.

4. A method as in claim 3 wherein the associated rate is a negotiated rate agreed to by a

20 customer sending the traffic data.

5. A method as in claim 4 wherein the profile is a burst-rate profile.

6. A method as in claim 5 wherein the periodic worst-case delay is calculated by dividing the burst parameter by a allocated bandwidth associated with the queue.

7. A method as in claim 1 wherein the queue is allotted a share of an output link capacity,

5   said share exceeding the associated rate.

8. A method as in claim 1 wherein the traffic aggregate is a class of traffic.

9. In a packet switched network, a method of estimating worst-case queuing delay along a

10   path, said path comprising routers, the method comprising:

periodically collecting traffic parameters associated with a queue for each of a plurality

of routers;

calculating a periodic worst-case delay associated with the traffic parameters for said

each of a plurality of routers; and

15   adding up the delay associated with the routers along the path.

10. A method as in claim 9 wherein the traffic parameters include a burst parameter and a rate

parameter.

20   11. In a packet switched network, a method of estimating periodic worst-case queuing delay

for a class of traffic at a router, the class of traffic having a negotiated rate, the method

comprising:

receiving packets at an input interface;

sending each packet to one of a plurality of streams responsive to a customer identification;

sending each packet in at least one of the plurality of streams to one of a plurality of queues responsive to a class field;

5 monitoring an arrival time and size of said each packet at the one of the plurality of queues during an interval of time;

calculating a traffic profile responsive to the arrival time and size of said each packet and the negotiated rate; and

calculating a periodic worst-case delay for the traffic profile.

10 11. A method for calculating periodic worst-case queuing delay associated with a hypothetical link bandwidth allocation and a set of traffic data, comprising:

calculating a burst parameter given the hypothetical link bandwidth allocation;

determining a periodic worst-case delay for a traffic profile associated with the burst

15 parameter and the hypothetical link bandwidth allocation.

12. A method for calculating worst-case queuing delay associated with a bandwidth and a set of traffic data, comprising:

calculating a burst parameter responsive to the bandwidth and the set of traffic data;

20 determining a periodic worst-case delay for a traffic profile associated with the burst parameter and the link bandwidth.

13. In a packet switched network, an apparatus for estimating worst-case delay for a traffic aggregate having an associated rate, the apparatus comprising:

a monitor that collects traffic data at a queue associated with the traffic aggregate over a time interval;

a processor; and

a computer readable medium coupled to the processor and storing a computer program

5   comprising:

code that causes the processor to receive the traffic data;

code that causes the processor to calculate a traffic profile responsive to the collected traffic data and the associated rate; and

code that causes the processor to calculate a periodic worst-case delay for the

10   traffic profile.

14. An apparatus as in claim 13 wherein the traffic data includes packet size and arrival time of each packet arriving at the queue during the time interval.

15   15. An apparatus as in claim 13 wherein calculating the profile includes calculating a burst parameter.

16. An apparatus as in claim 13 the profile is a burst-rate profile.

20   17. An apparatus as in claim 13 wherein the periodic worst-case delay is calculated by dividing the burst parameter by a allocated bandwidth of the queue.

18. The system of claim 13, wherein the computer readable medium is a CD-ROM, floppy disk, flash memory, system memory, hard drive, or data signal embodied in a carrier wave.

19. In a packet switched network, an apparatus for estimating periodic worst-case queuing delay along a path, said path comprising routers, the apparatus comprising:

a monitor agent that periodically collects traffic parameters associated with a queue for

5   each of a plurality of routers;

a processor that can receive information from the monitor agent; and

a computer readable medium coupled to the processor and storing a computer program comprising:

code that causes the processor to receive traffic parameters collected by the

10   monitor agent;

code that causes the processor to calculate a delay associated with the traffic

parameters for said each of a plurality of routers; and

code that causes the processor to add up the delay associated with the routers

along the path.

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20. An apparatus as in claim 19 wherein the traffic parameters include a burst parameter and

a rate parameter.

21. The apparatus of claim 19, wherein the computer readable medium is a CD-ROM, floppy

20   disk, flash memory, system memory, hard drive, or data signal embodied in a carrier wave.

22. In a packet switched network, an apparatus for estimating periodic worst-case delay for a

traffic aggregate having an associated rate, the apparatus comprising:

means for collecting traffic data at a queue associated with the traffic aggregate over a time interval;

means for calculating a traffic profile responsive to the collected traffic data and the associated rate; and

5   means for calculating a periodic worst-case delay for the traffic profile.

23. An apparatus as in claim 22 wherein the traffic data includes packet size and arrival time of each packet arriving at the queue during the time interval.

10   24. In a packet switched network, an apparatus for estimating periodic worst-case queuing delay along a path, said path comprising routers, the apparatus comprising:

means for periodically collecting traffic parameters associated with a queue for each of a plurality of routers;

means for calculating a delay associated with the traffic parameters for said each of a

15   plurality of routers; and

means for adding up the delay associated with the routers along the path.

25. An apparatus as in claim 24 wherein the traffic parameters include a burst parameter and a rate parameter.

20   26. A computer program product for estimating periodic worst-case delay at a queue in a packet switched network, the computer program product comprising:

computer code that causes a processor to collect traffic data at the queue over a time interval, said traffic data having an associated negotiated rate;

computer code that causes a processor to calculate a traffic profile responsive to the

collected traffic data and the associated negotiated rate;

computer code that causes a processor to calculate a periodic worst-case delay for the

traffic profile and a allocated bandwidth associated with the queue; and

5   a computer readable medium storing said computer code.

27. A computer program product as in claim 25 wherein the traffic data includes packet size

and arrival time of each packet arriving at the queue during the time interval.

10   28. A computer program product for estimating worst-case queuing delay along a path in a

packet switched network, said path comprising routers, the computer program product

comprising:

computer code that causes a processor to collect traffic parameters associated with a

queue for each of a plurality of routers;

15   computer code that causes the processor to calculate a delay associated with the traffic

parameters for said each of a plurality of routers; and

computer code that causes the processor to add up the delay associated with the routers

along the path; and

a computer readable storage medium storing said code.

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29. An apparatus as in claim 28 wherein the traffic parameters include a burst parameter and

a rate parameter.

30. In a packet switched network, a method of estimating worst-case queuing delay along a

path, said path comprising routers, the method comprising:

    calculating periodic worst-case delay associated with a queue for each of a plurality of

routers;

5   periodically collecting periodic worst-case delay from said each of a plurality of

routers; and

    adding up the delay associated with the routers along the path.

31. A method as in claim 30 wherein the traffic parameters include a burst parameter and a

10   rate parameter.